LISTEN. THINK. SOLVE.℠

Condition Monitoring Systems for Wind Turbine Manufacturers

Allen-Bradley • Rockwell Software

Rockwell Automation

Uptime is critical

Typical wind farm...

- Operated from site control room
- SCADA system access to each turbine
- Local HMI displays and records data history at each farm
- Specific datasets archived in central database

The condition monitoring system...

- Typically 10 – 20 channel, monitoring vibration on:
    - Main drive shaft bearings
    - Each gearbox / generator bearing
- May include an oil-particle counter (gearbox)
- Seamlessly integration of SCADA systems
- Provide detailed data for:
    - Spectrum analysis for trending
    - Longer term predictive maintenance
- Must work with SQL database servers
- Must be easily expanded

The benefits of a Rockwell Automation Solution

- Unparalleled flexibility
- Easy system development with MachineDynamix
- Simple to:
  - add number of sensors monitored
  - add more system control
  - add SCADA capabilities
- Ability to fully integrate TCU control functionality
- One control system (ControlLogix)
  - all programs directly transferable

Key attributes of Rockwell Automation Condition Monitoring

- MachineDynamix minimises required hardware and increases functionality
- Complete set of vibration measurement functions
- CompactLogix:
  - Helps obtain optimal measurement sets
  - Automatically identifies potential mechanical problems
  - Helps to preserve data if communications lost
  - Provides direct interface to historian and HMI displays
- State of the art vibration analysis – tracks condition of all machines
- Easy to add additional monitoring or control functionality
- Fully expandable to meet needs

The basic concept - MachineDynamix

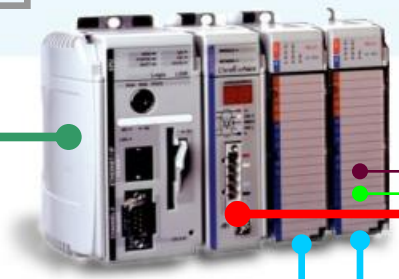
- Combines standard XM Series with CompactLogix automation controller
  - Automated surveillance-mode and data analysis
- Allen-Bradley XM Series
  - High-speed, real-time
  - Modular, DIN-rail mounted design
  - XM-121 - self-contained 2-channel + spectrum analysis
- Allen-Bradley Logix
  - Supports wide range of automation processes - sequential control, SCADA, process, motion etc.

The basic concept - MachineDynamix

CompactLogix manages monitoring system, collects and transfers data, generates alarms

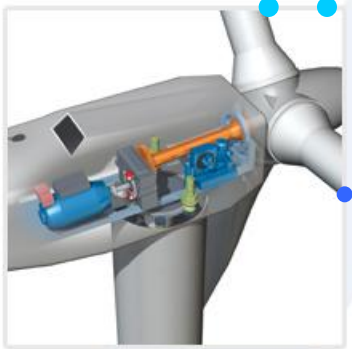
XM-121 Low Frequency module analyzes vibration data with spectrums and band alarms

DeviceNet controls XM-121 module and retrieves all data



Ethernet to computer in local control room. Computer manages and displays data from all turbines in wind farm. Transfers data files to Emonitor

Accelerometers wired to CompactLogix relay modules for multiplexing to XM-121



Speed sensor

The MachineDynamix Configuration

- CompactLogix
  - Complete data set every 2-5 minutes
  - Identifies specific mechanical problems in drive train
  - Requires Ethernet connection to control room...
    - ...allows HMI and process historian to access measurement data, analysis data and alarms
    - XM-Emonitor Gateway software runs on scheduled basis
  - Retrieves full data set – transfers to master monitoring computer, then main server

MachineDynamix Controller (1)

- MachineDynamix system controlled by CompactLogix
  - Logix controller, DeviceNet scanner, two relay cards
    - multiplexing
    - XM 121 configuration
    - data collection
    - data buffering
    - Comms
- System-controlled data collection sequence
  - Sequential accelerometer connection to XM-121
  - Concurrent downloading of definitions
  - Data read from module via DeviceNet
  - Next pair of accelerometers
- Flexibility during analysis
  - Add frequency band alarms
  - Take spectrums at more than one FMAX
- Custom analysis rules available

MachineDynamix Controller (2)

- All single value data available for trending and display
  - Via (standard) Ethernet link
- OPC Server functionality, if required
  - All data continuously tracked and displayed
  - All alarms immediately presented to operators
  - Data (option) uploaded to local process data historian
- If Ethernet connection lost
  - System can retain all time-stamped interval single value
    data for several hours (requires user system capability)
- For each wind farm
  - System running RSLinx and OPC Client software + XM-Emonitor Gateway software

Vibration Monitoring System

- XM-121
  - Accepts inputs from two accelerometers + one speed detector
  - Continuously makes single-value measurements for connected accelerometers:
    - Per accelerometer
      - Overall Vibration (RMS, Peak, Peak-to-Peak)
      - 1x, 2x, 3x Magnitude, 1x, 2x Phase
      - Sum Harmonic Energy
      - Not 1x Magnitude
      - (4) Programmable Frequency Band Alarms
    - Per XM-121 Module
      - Speed, Acceleration (RPM/Min), Max Speed
  - Provides time waveforms, up to 800 line spectrums, plus single value data
  - Includes 16 programmable two-level alarm outputs
  - Measurement definitions completely independent
  - Settings easily changed through integral DeviceNet

Emonitor Vibration Data Analysis System

- Emonitor
  - Accepted as leading vibration analysis software
  - Runs on central database server
  - Used to extract specific data from MachineDynamix system
  - Powerful data analysis and archive tool
  - 2 x simultaneous user licenses as standard - additional seats available
- Fully Windows compliant
  - Uses Oracle or MS SQL database server
- Primary database can be remote from analysis stations
  - At least one Emonitor Data Transfer Station at user's main server location
- Scheduled link with each wind farm
- Data imported into Emonitor Factory database

Emonitor Factory

- Emonitor Factory software
  - Can be loaded to multiple machines located anywhere
  - Optional Emonitor Web Client for remote data analysis
    - Read-only access
    - Requires standard Internet Explorer web browser
    - Excellent for data visibility across wind farms
- Powerful and flexible
  - High analysis capability
    - Develop tight spectrum band alarms that continuously update based on measured data
    - Add up to four process points per statistical alarm
    - Optimise data analysis processes
    - Automatically issue email alarm notifications
    - Intelligent Advisory Decision Module

Scalable solution

- MachineDynamix offers simple development and scalability
  - expand the number of sensors monitored
  - add more system control or SCADA capabilities
  - easy to integrate further sensors. e.g. an oil particle sensor could be added into the MachineDynamix system by the simple addition of an input card to the CompactLogix
  - adding more accelerometers - increasing from 10 to 14 accelerometers on the installation adds nothing to the MachineDynamix system
- Unmatched flexibility from any other potential solution
- Easy expansion to accommodate growth in wind turbine installations